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A review of the impacts of land use change, climate zone, forest type and age on soil organic carbon and other soil quality indicators following afforestation

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The main aim of this global review and systematic analysis was to investigate the impacts of previous land use system, climate zone and forest type and age on soil organic carbon (SOC), total nitrogen (TN) and total phosphorus (TP), in the different soil layers (0-20, 20-60 and 60-100 cm), following afforestation. We collected 85 publications on SOC, TN and TP stock changes, covering different countries and climate zones. The data were classified into groups depending on these investigated parameters and analyzed using R version 3.6.1. We found that afforestation significantly increased SOC and TN stocks in the 0-20 and 20-60 soil layers, with values of 45% and 44% for SOC, 30% and 22% for TN, respectively, but had no impact on TP stock. Previous land use systems had the largest influence on SOC, TN and TP stocks, with greater accumulations on barren land compared to cropland and grassland. Climate zone influenced SOC, TN and TP stocks, with significant accumulations in the moist than in the dry climate zone. Afforestation with broadleaf deciduous and broadleaf evergreen forests led to greater SOC, TN and TP accumulations in each soil layer throughout the investigated profile (0-100 cm), compared to coniferous forests. Afforestation for <20 years had significantly increased SOC and TN stocks only at the soil surface (0-20 cm) whilst afforestation for ≥ 20 years had significantly accumulated them up to 100 cm soil depth. TP stock did not change with the forest age, suggesting that it may become a limiting factor for carbon sequestration under the older-age forest. Following afforestation, the change of soil bulk density had inverse relationships with SOC or TN stocks changes but had no effect on TP stock change.